ENVIRONMENTAL TECHNOLOGY

Greenhouse–Power Plant Hybrid Set To Make Jordan's Desert Bloom

A novel combination of technologies that has the potential to turn large areas of desert green, producing commercial quantities of food and energy crops, fresh water, and electricity, looks set to have its first large-scale demonstration in Jordan. This week the governments of Jordan and Norway signed an agreement to work with the Sahara Forest Project (SFP), an environmental technology group based in Norway, to build a 20-hectare demonstration center near Aqaba on the Red Sea, which would begin operation in 2015. "It's a holistic approach that could be of major interest to a large number of countries," says Petter Ølberg, Norway's ambassador to Jordan.

The key to SFP is bringing seawater to the desert and evaporating it. A key component is the seawater greenhouse, developed by British inventor Charlie Paton. In Paton's scheme, seawater piped to the greenhouse trickles down over a grid structure that covers the windward side of the greenhouse. As natural breezes blow into the greenhouse through the grid, it evaporates the water, making an interior that is cool and moist—ideal conditions for growing crops. At the other end of the greenhouse, another grid evaporator, fed by seawater heated in black pipes on the greenhouse roof, loads more moisture into the air as it leaves the growing area. Now hot and very humid, the air passes through a maze of vertical polyethylene pipes cooled by cold seawater passing through them. Fresh water condenses on the pipes and trickles down into collectors, to be used for irrigation or drinking.

Since 1992, Paton's Seawater Greenhouse company has built pilot projects in Tenerife, Abu Dhabi, and Oman. Its first commercial contract, a 2000-square-meter greenhouse in Port Augusta, Australia, approved in 2009, harvested its first crop of tomatoes last month. To everyone's surprise, still-moist air blowing out of the pilot greenhouses turns the seemingly arid surrounding soil fertile: Weeds spring up unaided there, but they could just as easily be crops.

Paton teamed up with other experts in engineering, architecture, and environmental technology to form SFP. This group realized that a concentrated solar power plant would make an ideal partner for a seawater greenhouse.

Unlike photovoltaic systems, which convert sunlight directly into electricity, concentrated solar power uses mirrors to focus light onto a heat collector, which then produces steam to drive a turbine generator. Such solar plants work well in sunny desert areas, but they also need water both for cooling at the end of the power cycle and for cleaning the mirrors. A greenhouse could easily share seawater with a power plant; at the same time, the moist greenhouse and nearby vegetation would act as a natural air scrubber, filtering out much of the dust that would otherwise coat the plant's mirrors. In return, the solar plant would power the greenhouse.

Apart from Paton's prototype greenhouses, all of SFP's efforts so far have been theoretical. But a feasibility study drew plaudits at the COP15 climate summit in Copenhagen in 2009. "The Sahara Forest Project appears to be a very interesting example of the more integrated and holistic kind of thinking that we will need a lot more of in the future," said the European Union's energy commissioner at the time, Andris Piebalgs.

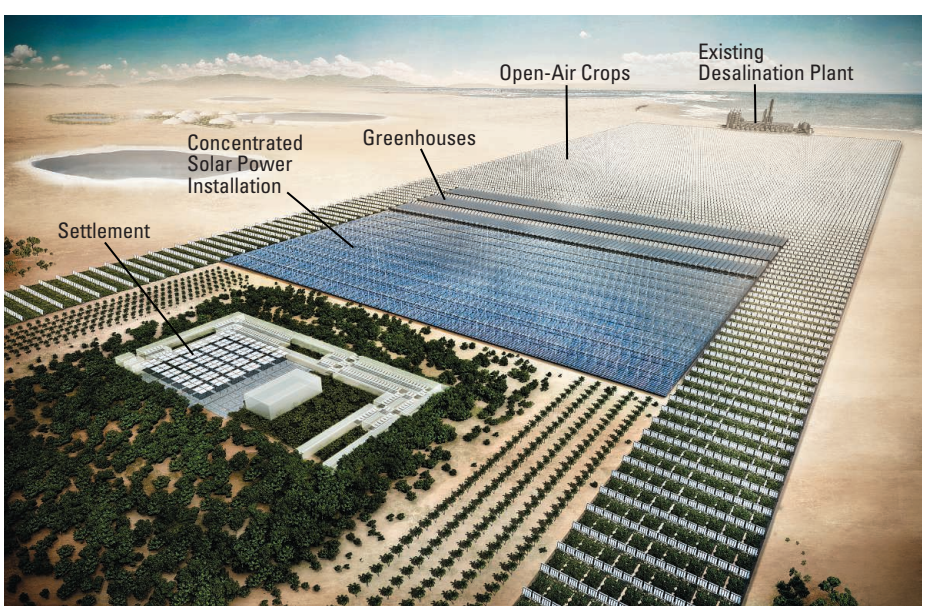
In June 2010, the project was presented to King Abdullah II of Jordan while he was visiting Oslo. The king invited an SFP team to visit Jordan in October and meet with five Jordanian ministers. And that led directly to this week's agreement. "The Jordanian authorities were very supportive and open," says Ølberg.

The agreement does not cover the construction cost of the demonstration center. Jordan will provide the 20-hectare site and a corridor to pipe salt water from the Red Sea. Norway will provide $600,000 for three studies: one to survey Jordan's potential for SFP-style facilities; a second to assess the Aqaba site; and a third to probe the possibility of building SFP plants alongside Jordan's planned pipeline to carry water from the Red Sea to the Dead Sea. Construction of the demonstration center will require private money; SFP chief Joakim Hauge says SFP is in discussions with several companies that are keen to invest in it.

The planned demonstration center devotes 4 hectares to greenhouses and 16 hectares to open-air crops, solar reflectors, and support buildings. The solar plant will use linear Fresnel reflectors, long, flat mirror strips that concentrate light onto a pipe carrying a heat-absorbing fluid. Hauge says the center will try out a variety of crops, including algae and halophytes, salt-tolerant plants that can be irrigated with seawater and used as biomass fuel. Salty waste water from an existing desalination plant will also be evaporated to provide more moisture for open-air crops. "The aim is to test as many technologies and combinations of technologies as possible," says Hauge.

SFP aims to start building in 2012 and to begin operations in 2015. If the project is successful, the Aqaba authorities will provide another 200 hectares for expansion.

–DANIEL CLERY



Just add water. SFP's combination of technologies coaxes crops, electricity, and fresh water from unproductive desert.

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